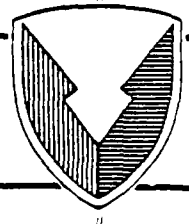
TECHNICAL REPORT RD-ST-89-3

TOW MOTOR CASE PAINT EVALUATION (U)

Steven F. Carr
Structures Directorate
Research, Development, and Engineering Center

AUGUST 1989



U.S. ARMY MISSILE COMMAND
Redstone Arsenal, Alabama 35898-5000

Approved for public release; distribution is unlimited.

DESTRUCTION NOTICE

FOR CLASSIFIED DOCUMENTS, FOLLOW THE PROCEDURES IN DoD 5200.22-M, INDUSTRIAL SECURITY MANUAL, SECTION II-19 OR DoD 5200.1-R, INFORMATION SECURITY PROGRAM REGULATION, CHAPTER IX. FOR UNCLASSIFIED, LIMITED DOCUMENTS, DESTROY BY ANY METHOD THAT WILL PREVENT DISCLOSURE OF CONTENTS OR RECONSTRUCTION OF THE DOCUMENT.

DISCLAIMER

THE FINDINGS IN THIS REPORT ARE NOT TO BE CONSTRUED AS AN OFFICIAL DEPARTMENT OF THE ARMY POSITION UNLESS SO DESIGNATED BY OTHER AUTHORIZED DOCUMENTS.

TRADE NAMES

USE OF TRADE NAMES OR MANUFACTURERS IN THIS REPORT DOES NOT CONSTITUTE AN OFFICIAL ENDORSEMENT OR APPROVAL OF THE USE OF SUCH COMMERCIAL HARDWARE OR SOFTWARE.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704-0188
Exp Date Jun 30, 1986

1a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

1b. RESTRICTIVE MARKINGS

2a. SECURITY CLASSIFICATION AUTHORITY

3. DISTRIBUTION/AVAILABILITY OF REPORT
Approved for public release; distribution unlimited.

2b. DECLASSIFICATION/DOWNGRADING SCHEDULE

4. PERFORMING ORGANIZATION REPORT NUMBER(S)
RD-ST-89-3

5. MONITORING ORGANIZATION REPORT NUMBER(S)

6a. NAME OF PERFORMING ORGANIZATION
Structures Directorate
Res, Dev, & Eng (RD&E) Center

6b. OFFICE SYMBOL (If applicable)
AMSMI-RD-ST-CM

7a. NAME OF MONITORING ORGANIZATION

6c. ADDRESS (City, State, and ZIP Code)
Commander
U.S. Army Missile Command
ATTN: AMSMI-RD-ST-CM
Redstone Arsenal, AL 35898-5247

7b. ADDRESS (City, State, and ZIP Code)

8a. NAME OF FUNDING/SPONSORING ORGANIZATION

8b. OFFICE SYMBOL (If applicable)

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

8c. ADDRESS (City, State, and ZIP Code)

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO

11. TITLE (Include Security Classification)
Tow Motor Case Paint Evaluation

12. PERSONAL AUTHOR(S)
Steven F. Carr

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Technical	FROM Apr 88 TO Jun 89		23

16. SUPPLEMENTARY NOTATION

17 COSATI CODES		
FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
TOW Motor Case
MIL-P-23377 epoxy primer
specimens
adhesion tests
surface preparation
paint set-up

19. ABSTRACT (Continue on reverse if necessary and identify by block number)
This report covers the evaluation of the application of MIL-P-23377 epoxy primer to interior surfaces of TOW motor cases.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT
☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION
UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL
Steven F. Carr

22b. TELEPHONE (Include Area Code)
(205) 876-3464

22c. OFFICE SYMBOL
AMSMI-RD-ST-CM

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted
All other editions are obsolete

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

I. INTRODUCTION

The main purpose of this work was to determine the best surface preparation and painting techniques for applying MIL-P-23377 epoxy primer to the interior of TOW motor cases. Adhesion of primer to the black oxide finish and the feasibility of coating interior surfaces of the motor case were evaluated. Once surface preparation and painting techniques were established, 15 motor cases were prepared for further evaluation.

II. BACKGROUND

The TOW motor case is made from maraging steel and is loaded with propellant sticks. The propellant sticks are in contact with the maraging steel case. An investigation of field failures of the case revealed that corrosion from the propellant was probably a contributing factor. A suggestion was made that the motor case be coated with MIL-P-23377 epoxy primer on interior surfaces in order to prevent corrosion from the propellant.

III. PROCEDURE

A. Specimen Preparation

Specimens for investigation were prepared by cutting motor cases in half longitudinally. This was accomplished by using a Buehler Ltd. cutoff wheel number 10-4412 for hard steel. Specimens are shown in Figures 1 and 2.

B. Surface Preparation

Three surface preparation techniques were evaluated using three specimens each. The first technique consisted of solvent cleaning using 1,1,1-trichloroethane and priming. The second technique included grit blasting prior to solvent cleaning and priming. The third technique consisted of the use of DOD-P-15328 wash primer after solvent cleaning and prior to priming.

C. Painting

Epoxy primer MIL-P-23377 was mixed one volume component A to one volume component B as required by specification. The mixed primer was allowed to stand for a minimum of 30 minutes before application. The paint was applied using a Devilbliss JGA-502 spray gun with a 30EX air cap/fluid tip combination. A minimum drying time of 72 hours was allowed before conducting adhesion tests.

IV. ADHESION TESTS

A. Procedure.

Wet tape adhesion tests were performed by submerging the specimens in water for 24 hours, removing, wiping dry, and scribing parallel grooves through to the base metal. Testing was performed using PPP-T-42 tape.

B. Results.

Adhesion tests results are shown in Figures 3 through 8. Some minor paint removal was noted on specimens which were only solvent cleaned prior to priming. No paint removal was noted in specimens which were grit blasted prior to priming. One of the specimens which had been treated with wash primer experienced an adhesion failure between the wash primer and epoxy primer. Based on these tests, solvent cleaning only was considered adequate and was chosen as the surface preparation technique to be used for preparing motor cases for further evaluation.

Figure 1. Adhesion test specimens, interior view.

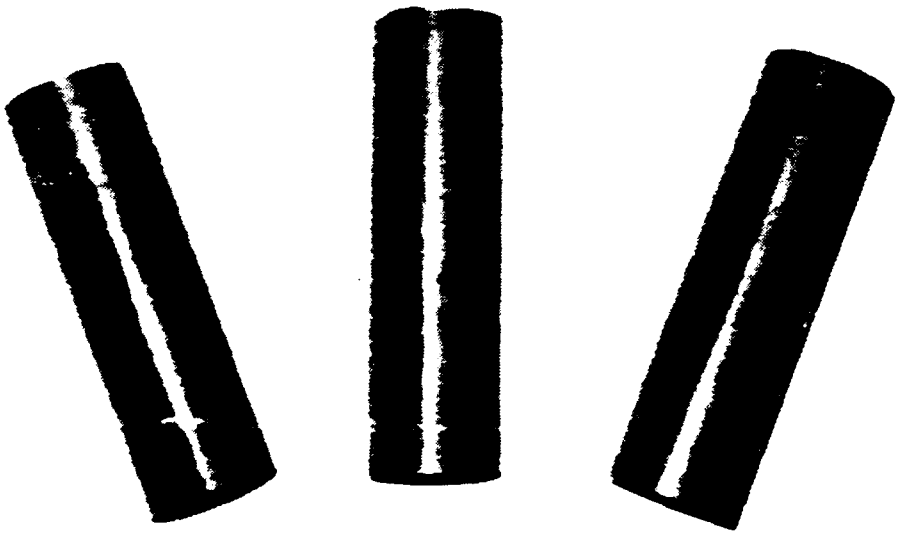


Figure 2. Adhesion test specimens, exterior view.

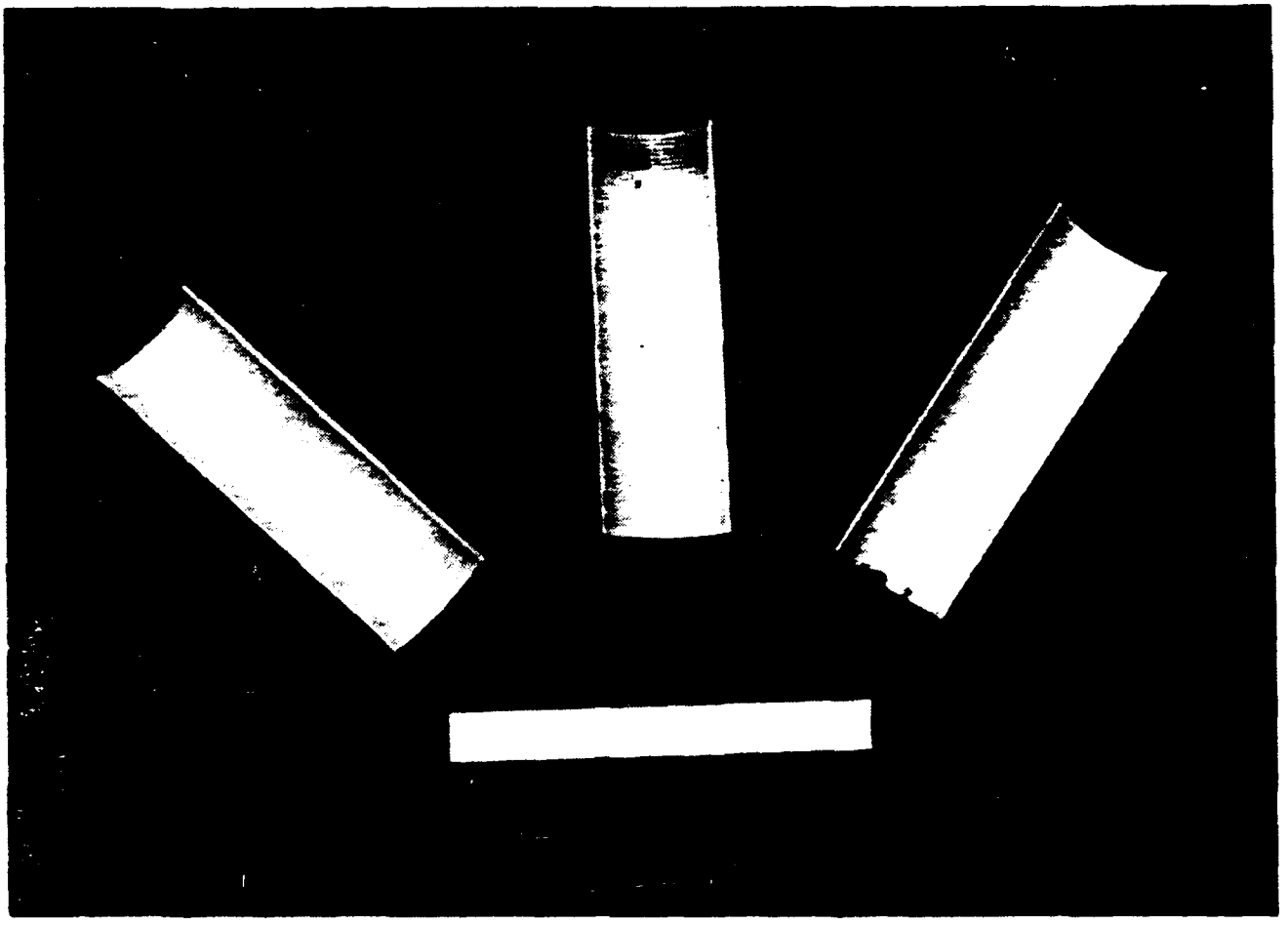


Figure 3. Adhesion test results - solvent cleaned only specimens, interior view.

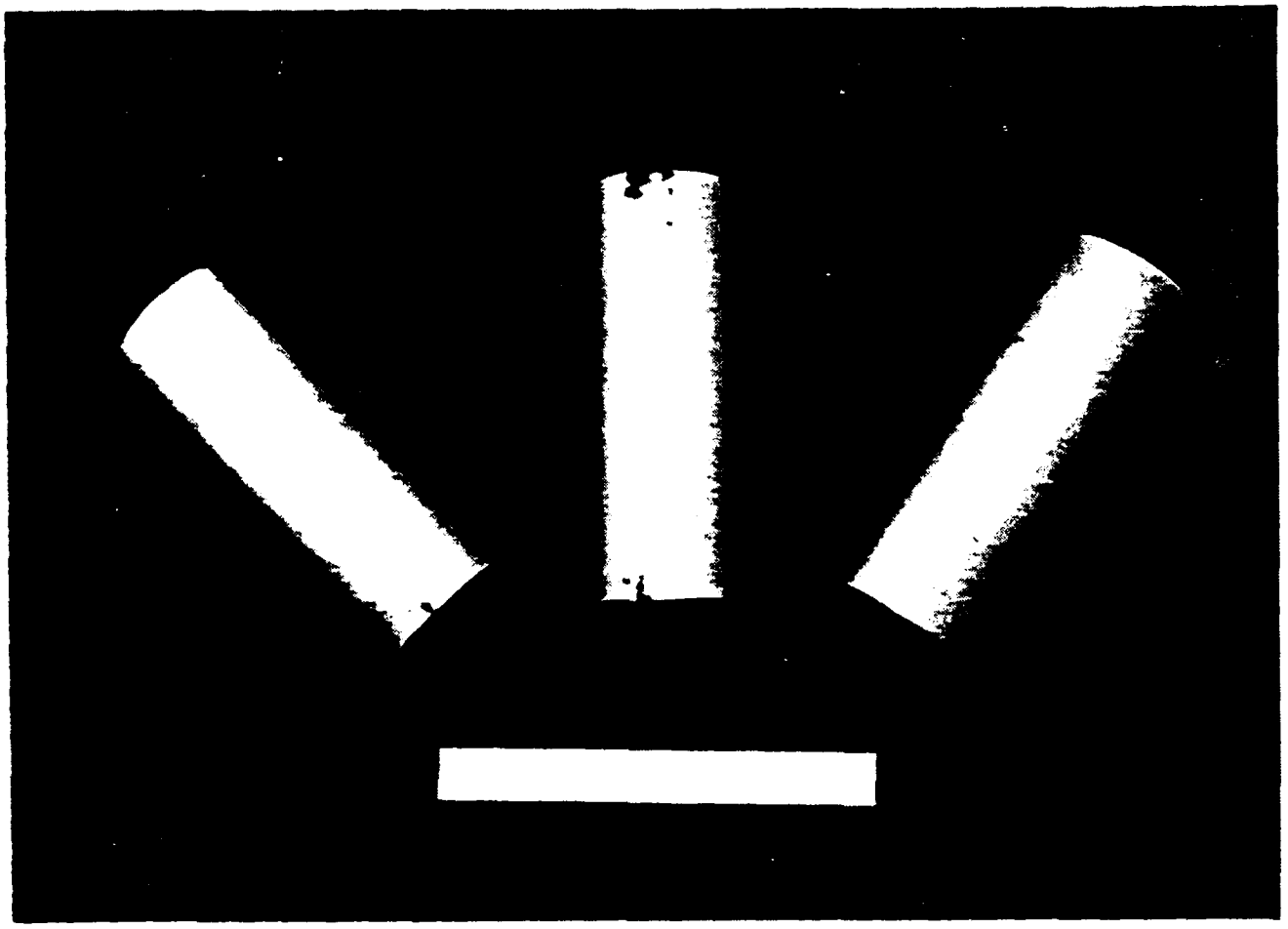


Figure 4. Adhesion test results - solvent cleaned only specimens, exterior view.

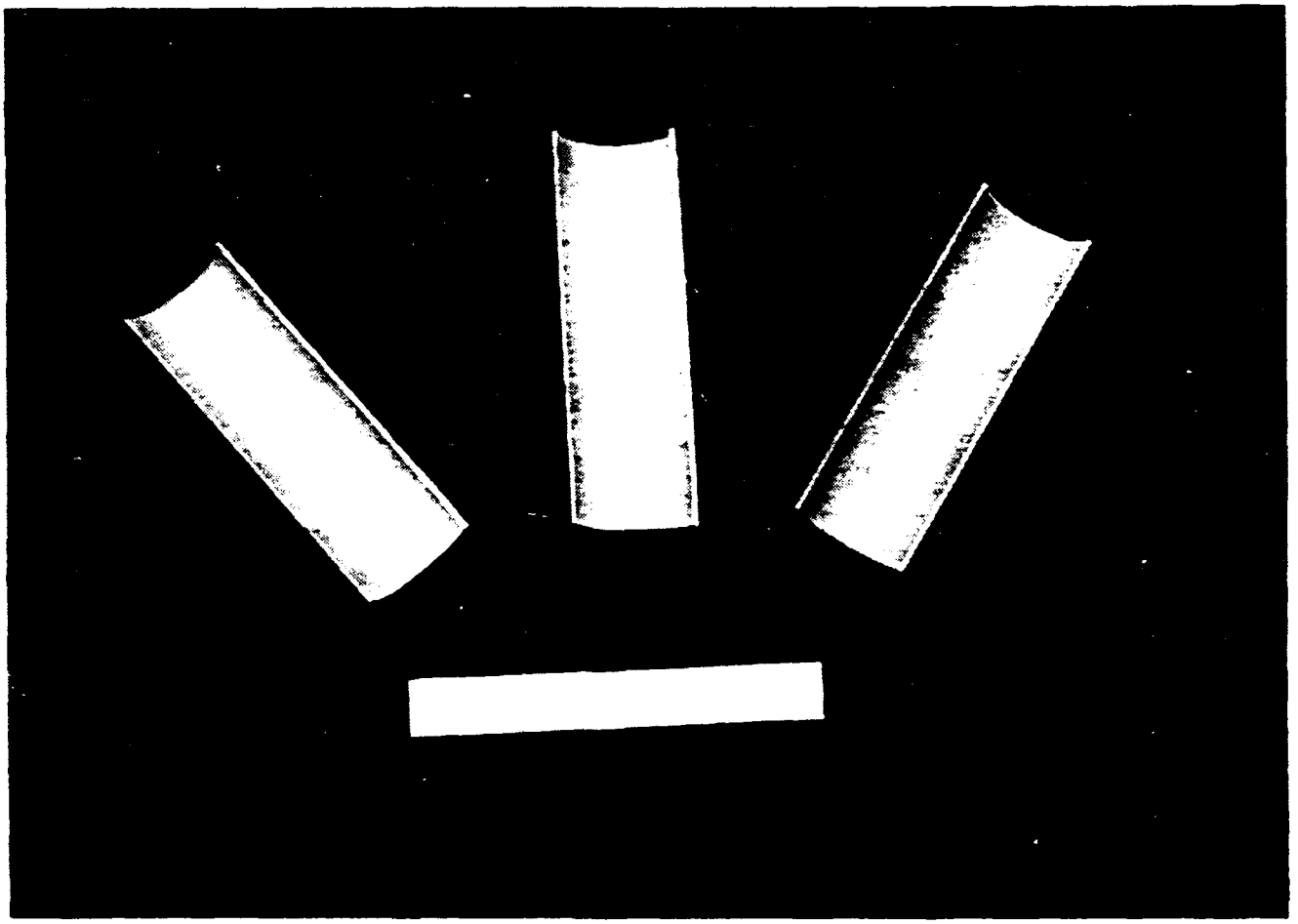


Figure 5. Adhesion test results - grit blasted specimens, interior view.

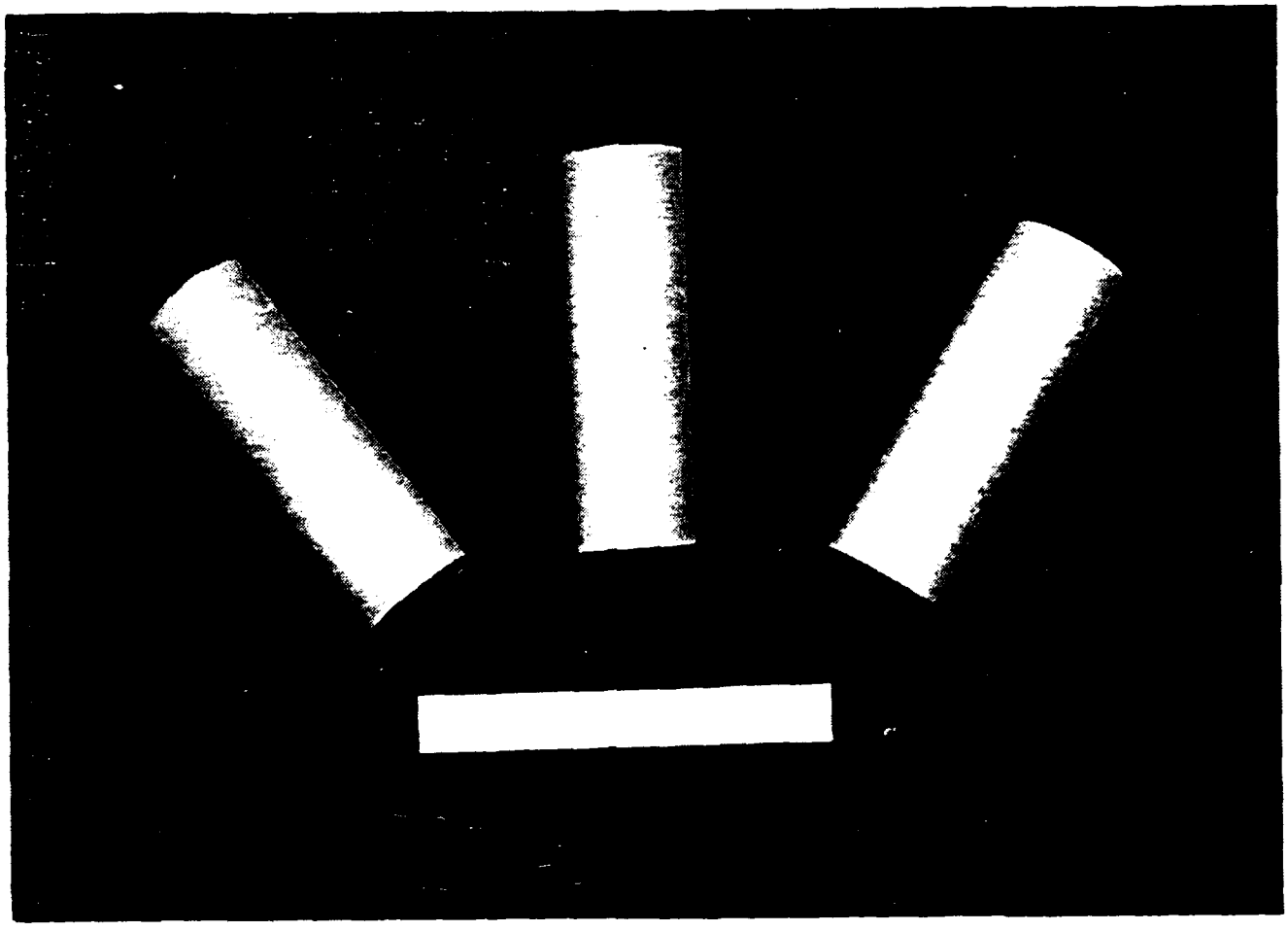


Figure 6. Adhesion test results - grit blasted specimens, exterior view.

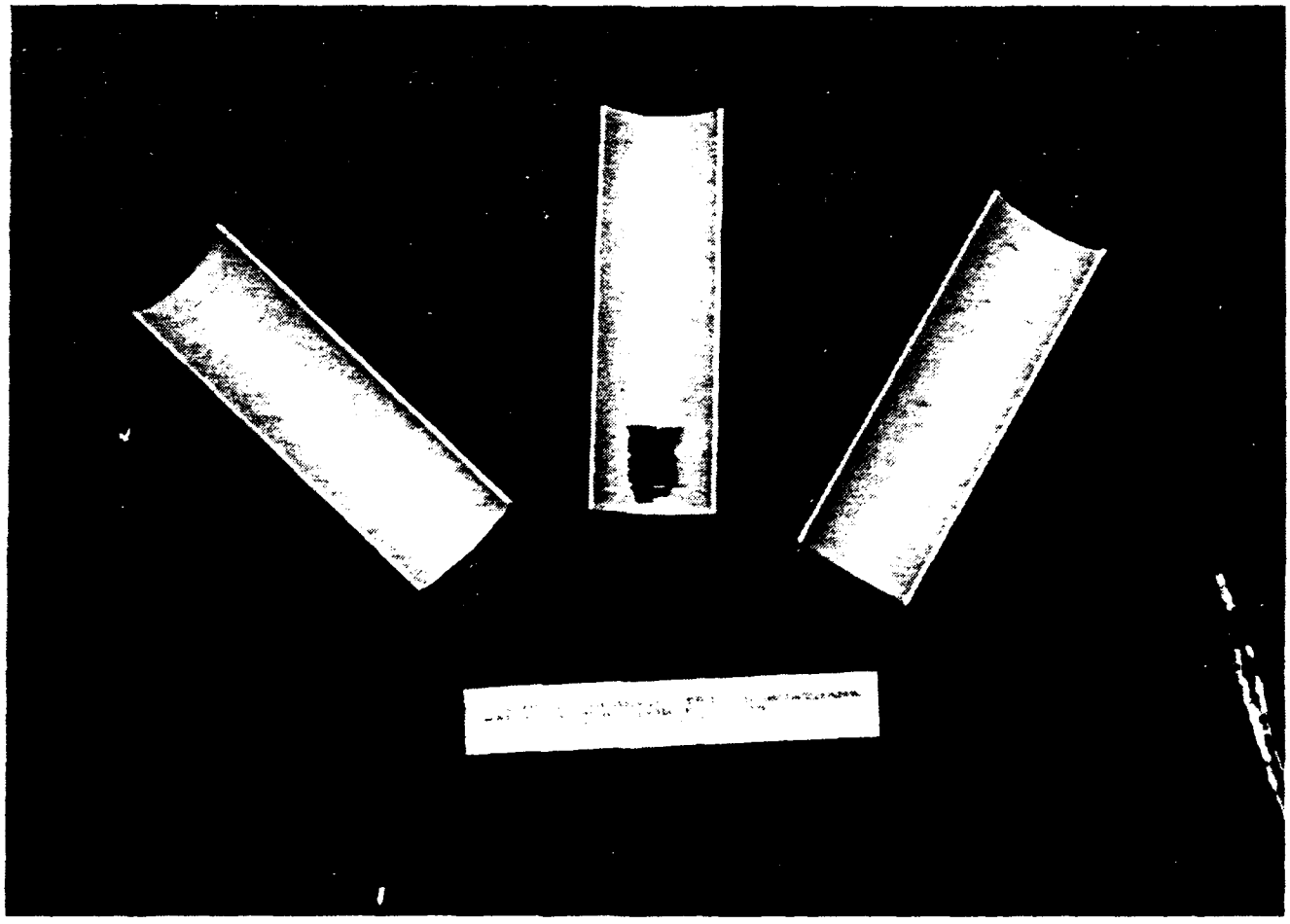


Figure 7. Adhesion test results - wash primed specimens, interior view.

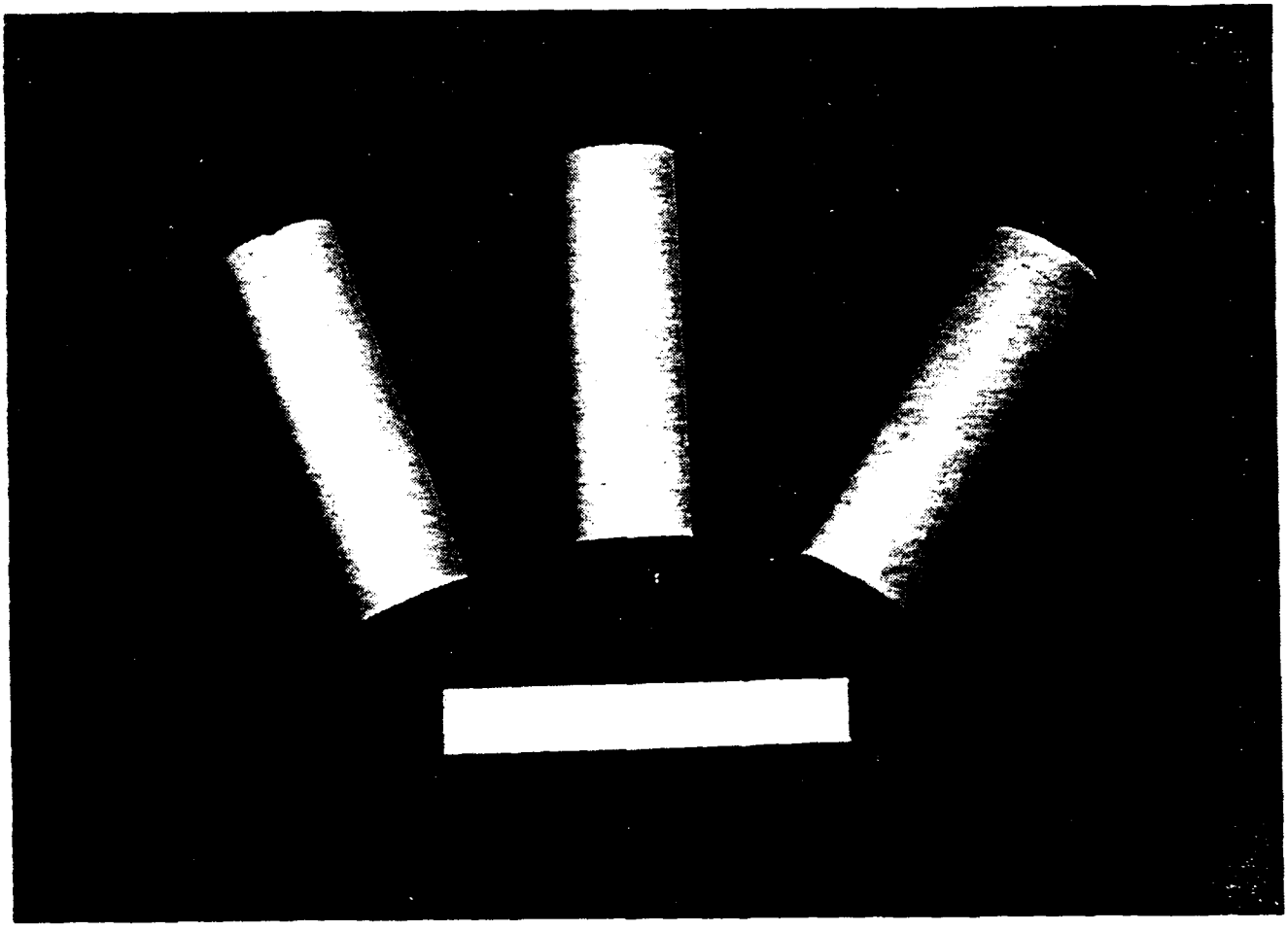


Figure 8. Adhesion test results - wash primed specimens, exterior view.

V. MOTOR CASE PAINTING

A. Specimens.

Twenty TOW motor cases made from T-250 maraging steel were received. These cases were solvent cleaned and coated with MIL-P-23377 epoxy primer on interior surfaces. Fifteen of these cases were supplied for further evaluation and the remaining five cases were for practice.

B. Setup.

A Devilbliss PMBC-428-3 paint spray gun was used with a MBX-4212-23 nozzle extension and a KB-521 pressure feed cup. The motor case was placed in a chuck so that it could be rotated during painting. Rotation provides better paint distribution and prevents running. A fixture was made to guide the nozzle through the center of the motor case during painting. Photographs of the spray gun, fixture, and motor case in the chuck are shown in Figures 9 through 11.

C. Preparation.

Motor cases were solvent cleaned by dipping in 1,1,1-trichloroethane. Each motor case was numbered and the approximate weight in grams was recorded. The nozzle threads on the aft end of the motor case were masked using tape and the motor case was placed in the chuck for painting.

D. Painting.

Painting was performed with the motor case rotating in the chuck. The nozzle was inserted through the fixture and into the motor case until it touched the conical front-end of the motor case. Spray was started and the nozzle was pulled from the motor case at a steady rate. A thickness check was made by sectioning a motor case and examining under a metallograph. The primer thickness was a minimum of 1 mil. Some problems were encountered with the nozzle hanging up in the fixture and with primer drying in the gun during breaks in painting. Epoxy thinner MIL-T-81772, Type II, was used to clean the spray gun.

E. Examination.

The finished motor cases were examined visually and the primer appeared to coat the cases uniformly. Motor cases were reweighed after painting in order to determine the amount of paint added. Results are shown in Table 1.

F. Thickness Calculation.

Density of cured MIL-P-23377 epoxy primer has been determined to be approximately 28.84g/in^3. The thickness of the primer on interior surfaces of the motor case can be calculated based upon the weight of primer applied.

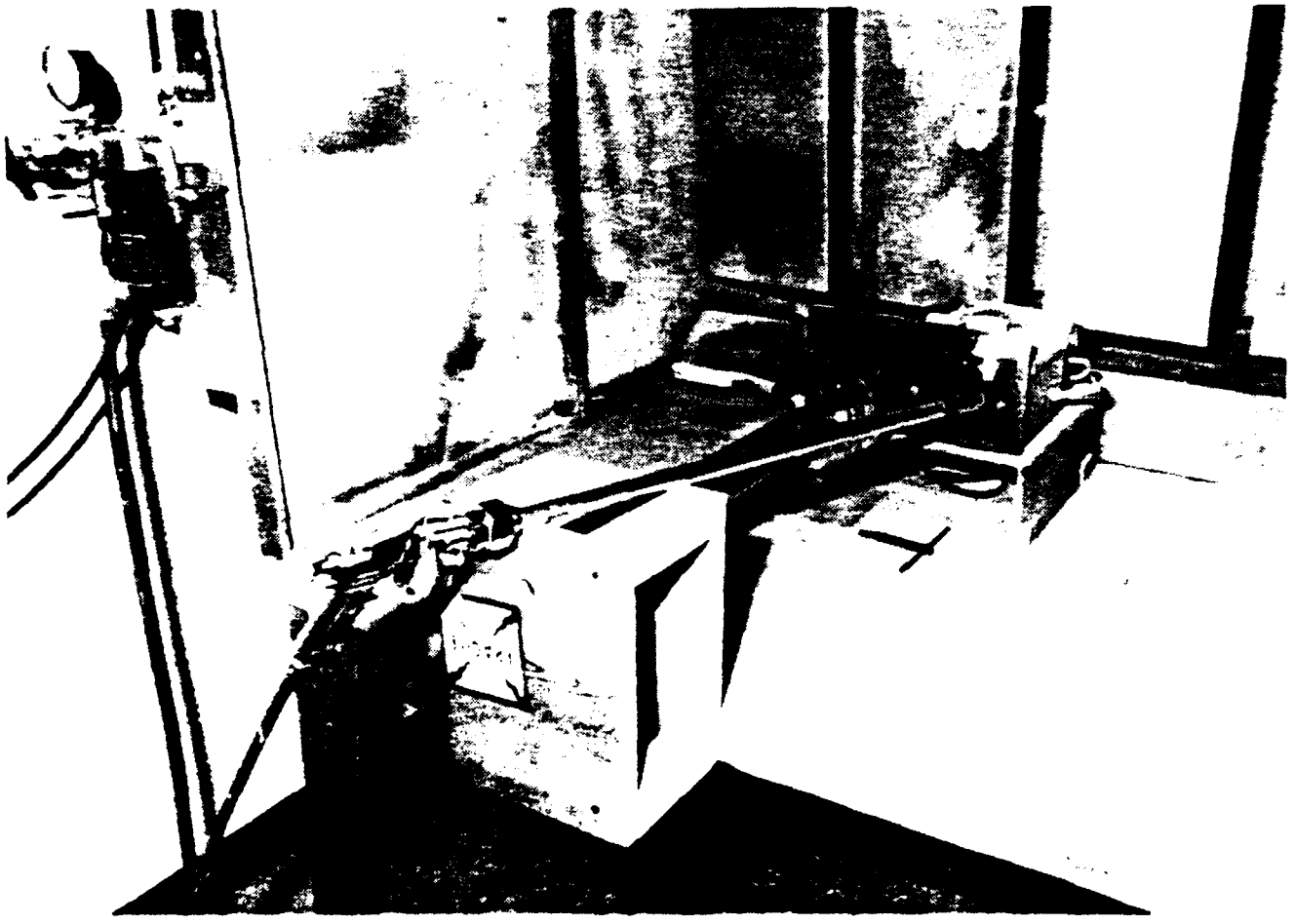


Figure 9. Paint spray setup showing spray gun.

Figure 10. Paint spray setup showing pressure feed cup.

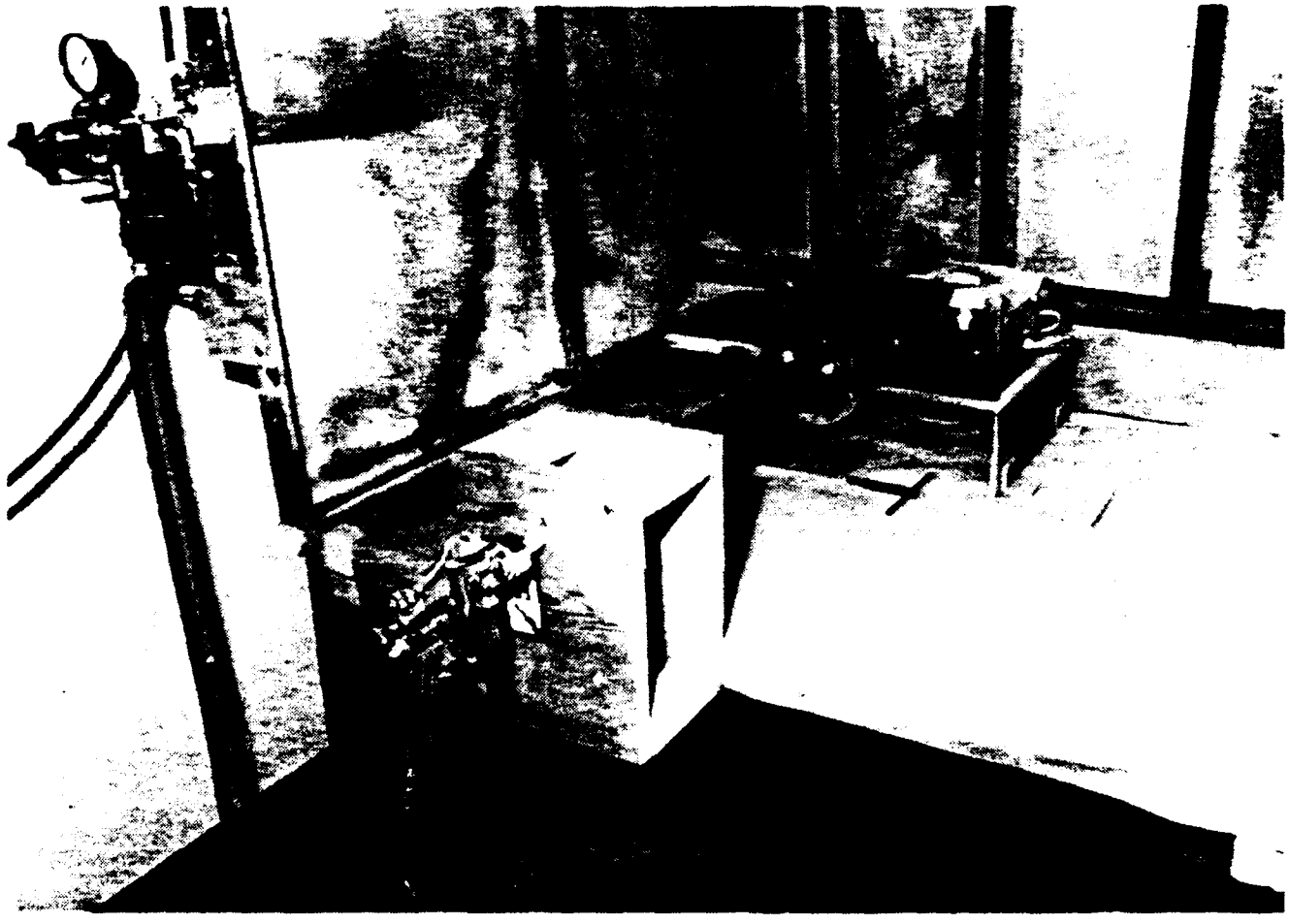


Figure 11. Paint spray setup showing fixture.

Example:

$$v = w/d$$

where v is the volume, w is the weight, and d is the density of primer.

Assuming an average weight of 2.5 g and substituting values:

$$v = 2.5/28.84 = .087 \text{ in}^3$$

Also for the motor case:

$$v = (\pi D)(L)(x)$$

where v = volume of primer

D = diameter of motor case (1.88 in.)

L = length of motor case (15 in.)

x = thickness of primer

Substituting values:

$$.087 = (5.91)(15)(x)$$

$$x = .001 \text{ in.}$$

TABLE 1. Coating Weight Determination
(Weight in Grams).

Specimen No.	Weight Before Painting	Weight After Painting	Weight Difference
3	985.7	989.7	4.0
4	985.0	989.0	4.0
6	986.3	990.0	3.7
7	991.0	993.0	2.0
8	1003.7	1006.0	2.3
9	979.5	981.7	2.2
12	988.3	990.3	2.0
13	992.3	994.0	1.7
14	998.3	1001.3	3.0
15	999.0	1002.5	3.5
16	990.5	992.3	1.8
17	984.7	986.5	1.8
18	988.3	990.0	1.7
19	992.3	994.5	2.2
20	995.0	997.3	2.3
			SUM = 38.2
			AVG = 2.5

VI. CONCLUSIONS

This work shows that priming of interior surfaces of TOW motor cases is a feasible way to protect them from corrosion due to propellant. Primer will adhere adequately to the black oxide finish of the motor case if it is solvent cleaned using 1,1,1-trichloroethane. Coating can be applied and controlled on interior surfaces of the motor case.

VII. RECOMMENDATION

It is recommended that TOW motor cases be primed with MIL-P-23377 epoxy primer on interior surfaces in order to prevent corrosion from the propellant.

DISTRIBUTION

	No. of Copies
U.S. Army Materiel System Analysis Activity ATTN: AMXSY-MP Aberdeen Proving Ground, MD 21005	1
ITT Research Institute ATTN: GACIAC 10 W. 35th Street Chicago, IL 60616	1
AMSMI-RD, Dr. McCorkle Dr. Rhoades Dr. Stephens	1
RD-ST, Dr. Mixon	1
RD-ST-CM, Mr. Howard	1
RD-ST-CM, Mr. Ray Parker	1
RD-ST-CM, Mr. Steven Carr	6
RD-ST-CM, Mr. Albert Ingram	1
RD-SE-PE, Mr. Tom Hart	1
RD-PR-S, Ms. Sandy Sanders	1
RD-PR-T, Mr. Jeff Allen	1
RD-CS-R	15
RD-CS-T	1
AMSMI-GC-IP, Mr. Fred M. Bush	1
AMSMI-QA-QE-CC, Mr. Paul Guiterez	1
AMCPM-TO-E-G, Mr. Jerome Gore	1